

WHAT IS CLAIMED IS:

1. An in-line mixing apparatus for the substantially continuous preparation of liquid mixtures, comprising at least two stages serially connected to each other; said first stage comprising a first tubular chamber having an inlet end and an outlet end, means within said first chamber for mixing materials introduced therein with a carrier fluid flowing therethrough, a means connected to said inlet end of said first chamber for introducing a controlled amount of a carrier fluid into said first chamber, and at least one means connected to said first chamber for separately introducing into said chamber a controlled amount of a component material to be mixed with said carrier fluid; and a second stage comprising a second tubular chamber having an inlet end and an outlet end, wherein said inlet end of said second chamber is in flow communication with said outlet end of said first chamber.
2. The mixing apparatus of claim 1, wherein said means for introducing a controlled amount of a component material to be mixed with said carrier fluid comprises an injector mounted in said first tubular chamber for injecting materials into said chamber, and a flow regulator connected to said injector for regulating the amount of said component material introduced through said injector.
3. The mixing apparatus of claim 2, wherein said flow regulator comprises an adjustable output pump and flow meter.
4. The mixing apparatus of claim 1, wherein said means for introducing a controlled amount of a component material to be mixed with said carrier fluid comprises at

least one injector mounted within a cylindrical ring having an internal diameter substantially the same as said first chamber, said ring being affixed to said first chamber upstream of said outlet end and in flow communication therewith; and a flow regulator connected to said injector for regulating the amount of said component material introduced through said injector.

5. The mixing apparatus of claim 4, wherein said flow regulator comprises an adjustable output pump and flow meter.
6. The mixing apparatus of claim 5, wherein said second tubular chamber is larger in diameter and in length than said first tubular chamber.
7. The mixing apparatus of claim 6, further comprising at least one means for introducing a controlled amount of a component material into said second chamber.
8. The mixing apparatus of claim 5, further comprising a third stage, comprising a third tubular chamber having an inlet end and an outlet end, wherein the inlet end of said third chamber is in flow communication with the outlet end of said second chamber; and means within said third chamber for mixing materials flowing therethrough.
9. An apparatus for the substantially continuous preparation and application of a size composition to glass fibers, comprising an in-line mixer for preparing the size in flow communication with an applicator for applying said size to said fibers.

10. The apparatus of claim 9, wherein said in-line mixer comprises at least two serially connected stages, said first stage comprising a first tubular chamber having an inlet end and an outlet end, means within said first chamber for mixing materials introduced therein with a carrier fluid flowing therethrough, a means connected to said inlet end of said first chamber for introducing a controlled amount of a carrier fluid into said first chamber, and at least one means connected to said first chamber for introducing into said chamber a controlled amount of a component material to be mixed with said carrier fluid; and a second stage comprising a second tubular chamber having an inlet end and an outlet end, wherein said inlet end of said second chamber is in flow communication with said outlet end of said first chamber.
11. The apparatus of claim 10, wherein said means for introducing a controlled amount of a component material to be mixed with said carrier fluid comprises an injector mounted in said first tubular chamber for injecting materials into said chamber, and a flow regulator connected to said injector for regulating the amount of said component material introduced through said injector.
12. The apparatus of claim 11, wherein said flow regulator comprises an adjustable output pump and flow meter.
13. The apparatus of claim 10, wherein said means for introducing a controlled amount of a component material to be mixed with said carrier fluid comprises at least one injector mounted within a cylindrical ring having an internal diameter substantially the same as said first chamber, said ring being affixed to said first chamber upstream of said outlet end and in flow communication therewith; and a flow regulator connected

to said injector for regulating the amount of said component material introduced through said injector.

14. The apparatus of claim 13, wherein said flow regulator comprises an adjustable output pump and flow meter.

15. The apparatus of claim 14, wherein a plurality of injectors, each connected to an adjustable output pump, are mounted within said cylindrical ring for introducing controlled amounts of a plurality of different component materials.

16. The apparatus of claim 10, wherein said second tubular chamber is larger in diameter and in length than said first tubular chamber.

17. The apparatus of claim 16, further comprising at least one means for introducing a controlled amount of a component material into said second chamber.

18. The apparatus of claim 10, further comprising a third stage, comprising a third tubular chamber having an inlet end and an outlet end, wherein said inlet end is in flow communication with said outlet end of said second chamber; and means within said third chamber for mixing materials flowing therethrough.

19. The apparatus of claim 18, further comprising at least one injector mounted within a cylindrical ring having an internal diameter substantially the same as said second chamber, said ring being affixed to said outlet end of said second chamber and in flow communication with both said second and said third chambers to permit the

introduction of a controlled amount of a component material to the fluid entering the third chamber; and a flow regulator connected to said injector for regulating the amount of said component material introduced through said injector.

20. The apparatus of claim 18, further comprising at least one injector mounted within a cylindrical ring having an internal diameter substantially the same as said third chamber, said ring being affixed to said third chamber and in flow communication therewith to permit the introduction of a controlled amount of a component material to the fluid flowing through said third chamber; and a flow regulator connected to said injector for regulating the amount of said component material introduced through said injector.
21. The apparatus of claim 10, further comprising a means for monitoring the application rate of said size to said glass fibers and automatically adjusting the volumes of carrier fluid and component materials introduced into said mixer to maintain a substantially constant supply of size at the applicator reservoir.
22. The apparatus of claim 10, further comprising a means for monitoring the concentration of a component material in said size between said mixer and applicator and automatically adjusting the volumes of the carrier fluid and component materials introduced into said mixer to maintain said concentration at a substantially constant value.
23. A process for supplying a glass fiber size applicator with size on a substantially continuous basis, said process comprising:

- (1) continuously introducing a carrier fluid at a controlled flow rate into an end of a tubular mixing chamber;
- (2) continuously introducing components of said size at a controlled rate into said carrier fluid flowing through said mixing chamber;
- (3) continuously mixing said components and carrier fluid as they flow through said mixing chamber; and
- (4) continuously flowing said mixture from said mixing chamber to said size applicator.

24. The process of claim 23, wherein said mixture exiting said mixing chamber is passed through at least one additional tubular chamber to provide sufficient residence time to allow chemically reactive components to react prior to flowing said mixture to said applicator.